Estimation of Vegetation Variables Using AIRSAR Data Containing Multiple Scattering Mechanisms

M. Moghaddam and S. Saatchi
Jet Propulsion Laboratory, MS 300–227, Pasadena, CA 91109

Radar backscattering data at different frequencies and polarizations contain information about various parts of a complex vegetated surface. Each radar channel, identified with its frequency and polarization, is sensitive to a particular set of the so-called scattering mechanisms which may be different from that of the other channels. The major scattering mechanisms generally present in radar backscatter from a vegetated surface are volume scattering from the branch and foliage layer, direct ground scattering, and double-bounce scattering between the ground and stems or branches. On a general qualitative level, the higher frequencies and the HV polarization are more sensitive to the branch layer volume scattering, whereas the lower frequencies and the HH (and sometimes VV) polarizations are sensitive to the double-bounce mechanisms. The ground backscatter is also sensed mainly by the lower frequencies and the HH and VV polarizations. Although such qualitative generalizations may be intuitive, quantifying such relationships for different vegetation types is not trivial. In this work, we make use of two of our previously developed mechanism-specific estimation algorithms to solve the quantitative multiple-mechanism estimation problem. The volume scattering and the double-bounce scattering estimation algorithms at appropriate frequencies and polarizations of the AIRSAR, augmented with a simplified ground backscatter estimation algorithm, are used to estimate their respective variables of the vegetation canopy and ground. Branch layer variables found from, e.g., volume scattering at C-band HV and HH channels, are used to predict the branch layer L- and P-band radar backscatters, which are subtracted from the total backscatter at those frequencies, leaving the double-bounce and ground backscatter contributions. These in turn are used to estimate the trunk and ground variables of the vegetation stand using our previously developed algorithm. The site under study is the BOREAS southern study area near Prince Albert in Saskatchewan, Canada. AITSAR data were collected during several field campaigns in 1993, 1994, and 1995. Results from the 1994 data are presented, when most of the ground measurements occurred. Theground data are used to assess the accuracy of the multimechanism estimation algorithm.

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